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Management of Post Traumatic Wounds using Indigenously Developed Negative Pressure Wound Therapy Device

Sushma Sagar, Parvez Mohi Ud Din Dar, Amit Sattigeri, Subodh Kumar, Amit Gupta

Division of Trauma Surgery and Critical Care, Department of Surgery, JPN Apex Trauma Center, All India Institute of Medical Sciences, New Delhi-110023, India.

Corresponding Author:
Dr Sushma Sagar
Email: sagar.sushma@gmail.com

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Abstract

Background: Non-healing wounds are difficult to treat and pose a major challenge to health care facilities due to increased length of hospital stay. There are numerous therapeutic options for treating these hard to heal wounds, with varying degrees of success. Negative pressure wound therapy (NPWT) or vacuum assisted closure (VAC) is an effective therapeutic intervention to accelerate wound healing in patients with diabetic foot ulcers, pressure ulcers, surgical wounds, and complex traumatic injuries. *Methods & Procedures*: In this case series, the therapeutic efficacy of an NPWT device was evaluated in patients with difficult non-healing wounds. The results show that the NPWT system accelerated the wound healing in these complex and difficult-to-heal wounds for an improved healing outcome. *Conclusion*: The NPWT system is an efficient therapeutic option that can be used to reduce the healing time and associated wound infections for better treatment outcomes.

Keywords: Trauma, Infection, Skin Grafting, Wounds, Wound Healing.

Introduction

In recent years, negative pressure wound therapy (NPWT) has been widely used to treat complex and non-healing wounds occurring due to trauma, infections or other surgical procedures. It is a highly promising therapeutic strategy for wound management because it facilitates wound healing, reduces the number of dressings and nursing time, significantly reduces medical costs, and improves patients' quality of life [1]. NPWT promotes wound healing time by promoting granulation tissue growth, facilitating tissue epithelialization and contraction, and increasing tissue perfusion [2]. Although NPWT is a promising therapeutic intervention for wound care and management, its use is associated with very high treatment costs, thus making its use highly unaffordable, and severely limits its widespread use in budgets constrained healthcare facilities, a common occurrence in most of the developing world [3]. Therefore novel, affordable and efficient wound healing medical devices that can be easily used in developing countries are the need of the hour. The clinical findings of the present case report evaluate an NPWT device for wound healing. The results of the present clinical evaluation may provide an efficient and safe solution to accelerate wound healing, resulting in lower treatment costs and improving the quality of life of patients with chronic and acute wounds.

Methods and Procedures

We present a series of three case reports on the use of NPWT in patients admitted in a specialized trauma center at a major tertiary care hospital in India (IEC-265/04.05.2018, AA-4/05.04.2019, RP-2018/19). The Clinical Trial Registry of India (CTRI) registration number for the present study is CTRI/2019/0192/05. The NPWT device **[Fig.1]**

Fig.1: *The NPWT device developed by Inochi Care Private Limited, New Delhi, India, was used in the present study. It consists of a suction pump unit capable of generating a continuous vacuum of 40-200 mm Hg and a disposable, transparent 500 ml capacity canister for collecting the wound exudates.*

developed by Inochi Care Private Limited, New Delhi, India, was used in this study. It consists of a suction pump unit capable of generating a continuous vacuum of 40-200 mm Hg and a disposable, transparent 500 ml capacity canister for collecting the wound exudates. Sterilized polyurethane foam with a pore size of 400-600 microns was used for dressing. Each therapeutic cycle lasts for approximately 72 hours, depending on the size of the wound, and is set at continuous pressure of minus 125 mm Hg.

The cases are described as follows:

Case 1

After the road traffic injury, a 36-year-old man presented with a fracture of the left supra-trochanteric femur with associated femoral artery injury **[Fig.2a-c]**. The patient underwent urgent exploration and vascular repair, external fixation of femur fracture, and fasciotomy of the left lower leg. He had no underlying co-morbidities. The lateral fasciotomy wound was treated with NPWT therapy sessions. The patient reported significant pain relief after the first NPWT session. The initial dimensions of the wound were measured as 23.6×5.9 cm which reduced to 22.7×4.94 cm after the first session of NPWT. During two subsequent NPWT sessions in

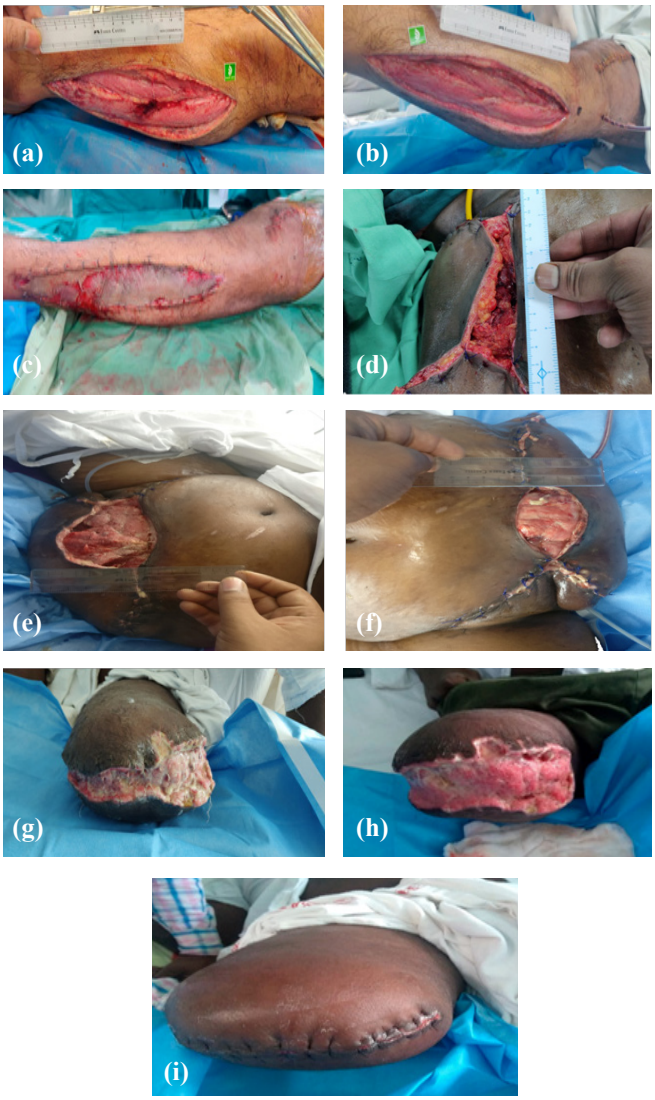

Fig.2: *The combined picture of three patients given NPWT therapy showed accelerated wound healing and wound contraction.Representative image of wounds from three patients at the beginning of NPWT therapy (pre-treatment,* **2a, 2d, 2g***). Representative image of wound from three patients after NPWT therapy session (post-treatment,* **2b, 2e, 2h***). Representative image of wound from three patients after NPWT therapy session and just before discharge (post-treatment,* **2c, 2f, 2i***).*

the next 6 days, the wound showed signs of healing and displayed a 13.3% increase in the granulation tissue formation and a significant reduction in pain was reported by the patient. After successful completion of three NPWT sessions, the wound was grafted on day 20 post-injury. The patient was then transferred to the orthopaedic department

for fracture fixation and was discharged from the hospital on day 42 post-injury.

Case 2

Another 45-year-old female patient was a pedestrian hit by a four-wheeler. She presented with a left femur fracture and severe left upper thigh degloving injury requiring disarticulation of the left hip **[Fig.2d-f]**. On post-operative day 4, the medial flap was found to be necrotic; a wound swab culture and sensitivity showed excessive growth of *E.coli* and *Proteus*. The wound was large and at a complex location. She had non-insulin-dependent diabetes mellitus and her blood sugar was well controlled.

The wound was debrided and the NPWT device was applied. She received seven sessions of NPWT and each NPWT session helped in wound healing thereby reducing wound area. On the initial presentation,the length and width of the wound were measured as 12×4.7 cm. After the first NPWT therapy, the length and width of the wound reduced to 9.0×3.90 cm. After the second therapy session, the length and width of the wound further reduced to 7.91×3.81 cm. The wound required seven sessions of NPWT application. There was a 15.67% improvement in the granulation tissue formation. After the successful completion of NPWT therapy, the wound was well granulated and split-thickness skin graft (STSG) was applied over the wound on the 39th post-injury day and was later discharged from the hospital on the 53rd post-injury day.

Case 3

A 41-year-old male patient presented twelve hours after a road traffic injury. He was a bike rider hit by a car. He had a right tibial fracture and right popliteal artery injury **[Fig.2g-h]** with the absent distal flow on CT angiography. A salvage attempt was made with the leg fasciotomy, but on the first post-operative day, the limb was found to be cold and numb with gangrenous changes in the leg. Right above-knee amputation was performed with delayed skin closure. The stump subsequently developed an infection on the eighth post-operative day. A wound swab culture was taken and the results showed growth of *Klebsiella*. The infected stump was debrided and NPWT was applied. After three cycles of NPWT and culture-based antibiotic therapy, complete wound closure using delayed primary suturing was achieved on the 20th post-operative day and the patient was discharged on the 22nd post-operative day. There was a 29.5% improvement in the granulation.

Discussion

NPWT therapy is a promising therapeutic intervention for faster wound healing and has gained popularity among clinicians. In NPWT, a wound dressing connected to a vacuum pump is placed on the wound, and the connected vacuum pump draws the exudate into a container, resulting in faster wound healing and a lower risk of microbial infection [4]. In addition, the use of NPWT can reduce the risk of developing certain wound-associated complications common to surgical procedures, such as hematomas, seromas, and microbial infections. In addition, NPWT offers the possibility of wound care in the home setting at an affordable cost [5]. In the present study, the therapeutic efficacy of the NPWT device was investigated. The clinical results of the present study show that therapeutic intervention with the NPWT system reduced wound area and improved tissue granulation. In addition, NPWT therapy prepared the wounds for definitive medical intervention such as suturing or grafting. It is important to note that no adverse events were reported during the use of the NPWT system, and the device was found to be safe for clinical use.

Conclusion

The NPWT device developed by Inochi Care Private Limited is a cheap and attractive alternative to standard wound dressings in traumatic wounds. It can be applied easily, improves wound

healing, reduces wound size and prevents wound contamination by maintaining wound seal. More studies on a larger number of patients need to be done using this NPWT device to confirm the results.

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